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Article in *Proceedings of the Geologists Association* · January 2019

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Interest in geological and palaeontological curiosities by southern African non-western societies: A review and perspectives for future study

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ARTICLE INFO

Article history:

Received 7 July 2018

Received in revised form 12 December 2018

Accepted 2 January 2019

Available online xxx

Keywords:

Geomythology

Fossils

Manuport

Quartz

Track

Rock art

ABSTRACT

Compared with other parts of the world, the study of geomythology in southern Africa, and the associated documentation of non-western awareness of palaeontological and geological phenomena, is in an early phase. We focus on examples of rocks and fossils as items of special interest and curiosity, and we search for evidence of an indigenous palaeontology and geology. We review twenty-one sites or cases for which published accounts exist, and we describe a newly identified trilobite manuport site. In combination these sites provide various levels of evidence of palaeontological and geological awareness exhibited by non-western cultures in southern Africa, and how these cultures incorporated this knowledge into their understanding of their world. We anticipate that in time a diverse heritage of such 'natural knowledge' may become evident in southern Africa, aided in part by recognition of the possibility that rock art images may be associated with awareness of body fossils and trace fossils. We suggest ways in which further analysis may bolster this contention.

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1. Introduction

The term 'geomythology' was coined by Dorothy Vitaliano (1973) in "*Legends of the Earth: their geologic origins*", and was defined as 'the study of the actual geologic origins of natural phenomena which were long explained in terms of myth and folklore'. Geomythology has become an expanding area of study due to the work of pioneers in the field like Adrienne Mayor (e.g. Mayor, 2000, 2011, 2004, 2005), Eric Buffetaut (e.g. Buffetaut, 1987, 2017), Thenius and Vávra (1996); Oakley (1975), and Abel (1939). While it retains the central concept of reviewing oral traditions to

explain geologic and other natural phenomena through metaphor and myth, it can also be used more broadly to investigate and document how pre-scientific cultures interpreted geological and fossil data, including fossil-related art and knowledge, which is the approach taken here. Ultimately, knowledge of local geomythology can lead the palaeontologist to the discovery of new important fossiliferous localities (Xing et al., 2011).

Numerous books (Buffetaut, 1987, 2017; Mayor, 2000, 2011, 2004, 2005), conferences and articles (e.g. Mayor and Sarjeant, 2001; Piccardi and Masse, 2007; Duffin, 2008; Van der Geer and Dermitzakis, 2008; Van der Geer et al., 2008; Godard, 2009; Liñán et al., 2011; Xing et al., 2011; Baucon et al., 2012) attest to the growing recognition of geomythology, especially within Europe, Asia and the Americas. A children's book is evidence of the suitability of this topic for educational purposes (Aronson and Mayor, 2014).

Contemporaneously with the work of Mayor and Buffetaut, Bednarik (2009, 2013) reviewed Early Stone Age palaeoart and

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African palaeoart, including manuports. These were described as unmodified objects collected, transported and deposited by hominins that can be identified when they occur in occupation deposits in which they could not possibly occur naturally. Such manuports typically possess something that aroused sufficient curiosity for them to be picked up and carried for some distance.

1.1. African sites

Although there has been no systematic attempt to gather and analyze geomyths and fossil-related legends on the African continent, intriguing accounts exist that point to a rich, underappreciated body of evidence for indigenous awareness of fossils and geological phenomena. We present these here in a north-to-south order.

1.1.1. North Africa

Mayor (2000) provided reports and interpretations from ancient Greek and Latin texts of fossils from multiple North African sites from Morocco, Tunisia, Libya and Egypt (many of which featured the remains of large Cenozoic animals and the long history of palaeontological discovery since the time of Homer. These descriptions involve familiar names from classical Greek and Roman times, such as Eratosthenes, Herodotus, Pliny, and Strabo (who recorded as improbable the notion that nummulites in rocks from which the Pyramids in Egypt were quarried represented the petrified remains of lentils from the meals of the builders) as well as later comments by St. Augustine, who lived in Carthage (now within Tunisia). A lesser-known writer is Phlegon of Tralles, whose *Book of Marvels* from the early 2nd century C.E. contains a whole section devoted to discoveries of giant bones (Hansen, 1996).

1.1.2. Algeria

Arabic legends of a mythical colossal bird (possibly related to the great Rukh or Roc-bird) are associated with Cretaceous dinosaur tracks in Algeria (Mayor and Sarjeant, 2001). Hearing about these beliefs, the French geologist Le Mesle hiked to the remote Amoura site in the eastern Saharan Atlas in 1880, noted 30 tracks, and concurred that they had probably been made by a giant prehistoric bird (Le Mesle and Peron, 1880). These theropod tracks turned out to be the first evidence of dinosaurs in North Africa (Buffetaut, 1987; Taquet, 2010; Chabou et al., 2015).

1.1.3. Morocco

Bednarik (2002) reported a Late Acheulian (300 ka) manuport, collected in 1984 in eastern Morocco from Erfoud archaeological site in the Sahara. This cast of a Triassic cephalopod fossil, which does not occur naturally in the region, bears a strong resemblance to a human penis; it is postulated that it was brought back to the dwelling due to its phallic appearance. This may be the earliest known manuport to be carried by a representative of our species *Homo sapiens* (Hublin et al., 2017).

1.1.4. Niger

A mass burial site of *Jobaria tiguidensis*, an immense Lower Cretaceous sauropod dinosaur, was excavated by Sereno et al. (1999) in Niger, West Africa. The dinosaur fossil sites of Niger were already known to the Tuareg nomads. Sereno's team had been led to the site in the Tiguidi Cliff area, after they had asked the nomads about places with very big bones of animals that they did not recognize (Mullen, 1999). Over centuries, Tuareg camel caravans had traveled through the rocky terrain where they observed enormous fossils weathering out of the desert cliffs. The nomads speculated that the great creatures had been killed by a vast flood. Sometimes the nomads referred to the massive bones as the remains of "giant camels" or "ancient animals". They also said the

skeletons belonged to 'Jobar', a huge beast of Tuareg folklore, said to seize naughty children. The sauropod found by Sereno and his team was named *Jobaria* after the indigenous name it already carried (pers. comm. J.-P. Cavigelli, February 27, 2001; Matt Wedel, March 6, 2001).

1.1.5. Uganda

The geologist-explorer E. J. Wayland (1924, 1927); Wayland, 1924 reported on local legends about earthquakes and exotic boulders in the landscape of Uganda. He also suggested that the Nandi Bear, a legendary monstrous beast of Uganda and East Africa, may have been related to observations of fossils of unknown extinct creatures of Pliocene-Pleistocene age. The Nandi Bear was said to resemble a giant hyena or bear. Wayland thought that the fossil remains of chalicotheres, curious perissodactyls with large claws, might have inspired the legend, an hypothesis that was elaborated by Leakey (1935). Another candidate was the skeleton of a large carnivore the size of a brown bear discovered in Koru, near a cave believed to be the den of the Nandi Bear. As director of the Geological Survey of Uganda, Wayland sent memos to local administrators to query the local people about these legends. So far no one has looked into the official records to see what sort of replies and rumours were collected (pers. comm. Pat Shipman, January 3, 2002).

1.1.6. Cameroon

Shanklin (2007) described long-standing stories and myths involving exploding or 'misbehaving' lakes in the Cameroon Grassfields of West Central Africa. The historical basis for such stories and interpretations tragically became apparent in 1986, when one of these lakes, Lake Nyos, 'exploded', releasing a cloud of carbon dioxide that killed 1800 people.

1.1.7. Democratic Republic of the Congo

William Sanders collected a *Stegodon* molar manuport in 1983 at the Ishango site in eastern Zaire (now the Democratic Republic of the Congo) in a level dated to 21 ka (Mayor, 2000). Sanders notes in a pers. comm. (March 19, 2018) that the proboscidean *Stegodon kaisensis* went extinct in the mid Pliocene, so "local inhabitants of the Late Stone Age at Ishango had to have picked up the molar as a curiosity - it was very rolled (smoothed by water action) . . ." De Heinzelin de Braucourt (1957) and Peters (1990) also described a *Stegodon* molar manuport from Ishango, and provided a more recent age for the deposit in which it was found.

1.1.8. Tanzania

Tendaguru in Tanzania is one of the most important Mesozoic fossil sites in the world. Initial excavation of the Late Jurassic deposits took place in the early 20th century in what was then known as German East Africa. The dinosaur material was transported to Germany and is exhibited in Berlin's Museum für Naturkunde.

Artist-activists Nora Al-Badri and Jan Nikolai Nelles have recently interviewed the elders and others at Tendaguru about the fossils that were taken from their territories in Tanzania. Hindahl (2017) reports on their work:

"The colonial masters were actually looking for raw materials for arms production, but found something else as they were doing so. At least that's how the official story goes. 'Institutions frequently tell these stories in such a way that those discovering the exhibits are romanticized', says Nora Al-Badri. But: 'The bones were visible to everybody and the population of the Tendaguru hills knew exactly where they lay.' So in reality it was the local people who drew the attention of the Germans to these extraordinarily large bones at the foot of the Tendaguru. The indigenous population were subsequently put to work as burden-

bearers, carrying the fossils to the coast so that they could be shipped from there to Germany.”

Maier (2003) in reviewing almost a century of work on the Tendaguru dinosaurs mentions not only the manpower supplied by the Africans, but the work of the African guide and supervisor Boheti bin Amrani, and the skill of local workers in preparation and bone identification.

1.1.9. Contribution of African slaves to palaeontology

There is a final noteworthy contribution of Africans to palaeontological knowledge. Cuvier (1812) and later Mayor (2005) described how, in 1725, African slaves from Angola or the Congo identified massive molars that they had dug up in a swamp in South Carolina as belonging to a species of elephant. This correct identification (of mammoth molars) was the first vertebrate fossil identification reported in North America.

1.2. A paucity of southern African geomythological sites?

It appears nevertheless that Africa, and southern Africa in particular, has received a lot less attention than other continents in this respect. For example, Mayor (2004) in a summary of geomythology that includes examples from around the world, makes no mention of southern Africa. Likewise, the edited volume by Piccardi and Masse (2007) on geomythology contains only one chapter on Africa, pertaining to the above-mentioned site in Cameroon, and Mayor (2011) noted that further studies from Africa were eagerly awaited. One of us has recently drawn attention to this lack of published material (Benoit, 2017).

However, southern Africa has played a key role in the origin of early hominids over more than 3 Ma (e.g. Berger and Hilton-Barber, 2006; Granger et al., 2015) and of modern humans: early evidence of human adornment and artistic endeavor (e.g. Henshilwood et al., 2002, 2009, 2011), heat treatment of stone tools (Brown et al., 2009), microlithic technology (Brown et al., 2012) and the first documented use of seafood in the human diet (Marean et al., 2007; Marean, 2010) are all celebrated features of southern African heritage, archaeology and palaeoanthropology. These imply a sophisticated understanding of rocks and their properties, geological landscapes, and natural phenomena such as lunar cycles and tides.

Thousands of generations of human ancestors trod southern Africa's coastal and interior regions. The extensive Karoo Supergroup that covers most of central southern Africa, the coastal deposits of Namibia and the Cape region, and numerous cave deposits are noted for their wealth of conspicuous and recognizable fossils (e.g. Rubidge, 1995; MacRae, 1999; Durand, 2005; Berger and Hilton-Barber, 2006) that are naturally exposed. There would have been an abundance of fossil material for these ancestors to potentially appreciate, including numerous trackways containing large footprints (e.g. Ellenberger, 1970, 1974; Raath et al., 1990; Ambrose, 1991; Smith, 1993; De Klerk, 2003; Roberts et al., 2008; Smith et al., 2009; Sciscio et al., 2017; Helm et al., 2018). Such trackways are often exposed for long periods of time, which differentiates them from skeletal fossil material, which is often more transiently exposed (Xing et al., 2011). It is therefore possible that such fossil footprints would have been recognized for what they were, earlier than fossil bones (Lockley, 1991; Sarjeant, 1997a).

Over time one group, the San, became arguably the finest trackers and observers in human history (Thomas, 1958; Van der Post, 1958; Lockley, 1999; Marshall, 1999). They came from a long regional lineage (Deacon, 1992) and created a remarkably long artistic tradition (Lewis-Williams and Dowson, 1989). It seems unlikely that such a culture would not have been aware of the

trackways and fossils in stone of remarkable creatures that no longer appeared to exist.

We anticipate that in time a diverse non-western, indigenous palaeontological and geomythological heritage will probably become evident in southern Africa. The purpose of this article is to review published accounts in this field, to describe a new site, and to suggest a possible systematic future approach.

We acknowledge that an 'indigenous geology' is implicit in any selection, mining, and transportation of optimal rocks for tool-making or other practical purposes. As an example, ancient awareness that silcrete, when heated, allowed for the production of superior tools, constitutes outstanding, practical 'natural knowledge' (Brown et al., 2009). The rich southern African pre-colonial archaeological record of indigenous mining has been reviewed in detail (Beaumont, 1973; Miller, 1995; Hammel et al., 2000; Miller et al., 2000). However, in this article we do not focus on such manuports that were of immediate practical utility. Instead we focus on examples of rocks and fossils as items of special interest and curiosity, and more specifically we search for evidence of a non-western, indigenous palaeontology and geology.

Furthermore, there is a rich oral tradition of stories that account for conspicuous geographic features, including the Khoisan belief that the Great Fish River Canyon in Namibia was carved out by a giant snake (Miller, 1979) or the Xhosa tradition that the natural bridge known as esikhaleni (or Hole in the Wall) was carved by supernatural beings from the sea, using a giant fish as a ram (Miller, 1979). A further example lies in the isiZulu word for the Drakensberg mountain range: Qathlamba (translated as 'Barrier of Spears'). Evocative as these and similar examples are of an indigenous folklore that celebrated natural features, they do not appear to be based on specific awareness of fossils or rock types, and we therefore do not consider them further in our review.

Although written texts exist of European explorers and settlers encountering palaeontological material with great interest from as early as the 1800s (e.g. Lichtenstein, 1811; Latrobe, 1818; Grisbrook, 1830a; Alexander, 1838; Bain, 1856; Salter, 1856; Sharpe, 1856; Sharpe and Salter, 1856), the degree of awareness of this fossil material by non-western peoples remains virtually unknown, and little documented. In order to address this deficiency we present here a literature review of 21 published sites, and we describe one new site (Fig. 1).

2. Methods

Once we had established our area of focus, we determined a list of known sites that would fit within this focus. This was accomplished through assessing our combined knowledge base (which includes the disciplines of geology, geomythology, ichnology, palaeontology, evolutionary studies, archaeology and rock art), complemented with literature searches. These included the international literature, in order to identify sites with comparable features elsewhere in Africa and on other continents.

We encouraged reporting of potential sites through public presentations. The earlier work of Helm (2013), which included visiting reported sites and searching for new sites, was incorporated.

Once the new Cave 17 manuport site at Robberg was identified, it was reported to CapeNature, and it was assessed from a geological (H.C.) and archaeological (R.R.) perspective. The trilobite fossil was photographed, and was identified (C. P.-C.) following measurements of its dimensions and the mass of the manuport. Global Positioning System (GPS) readings of the site were obtained using a handheld GPS device, and were reposit in the African Centre for Coastal Palaeoscience and the Evolutionary Studies Institute. Measurements and photographs were taken of the rock shelter.

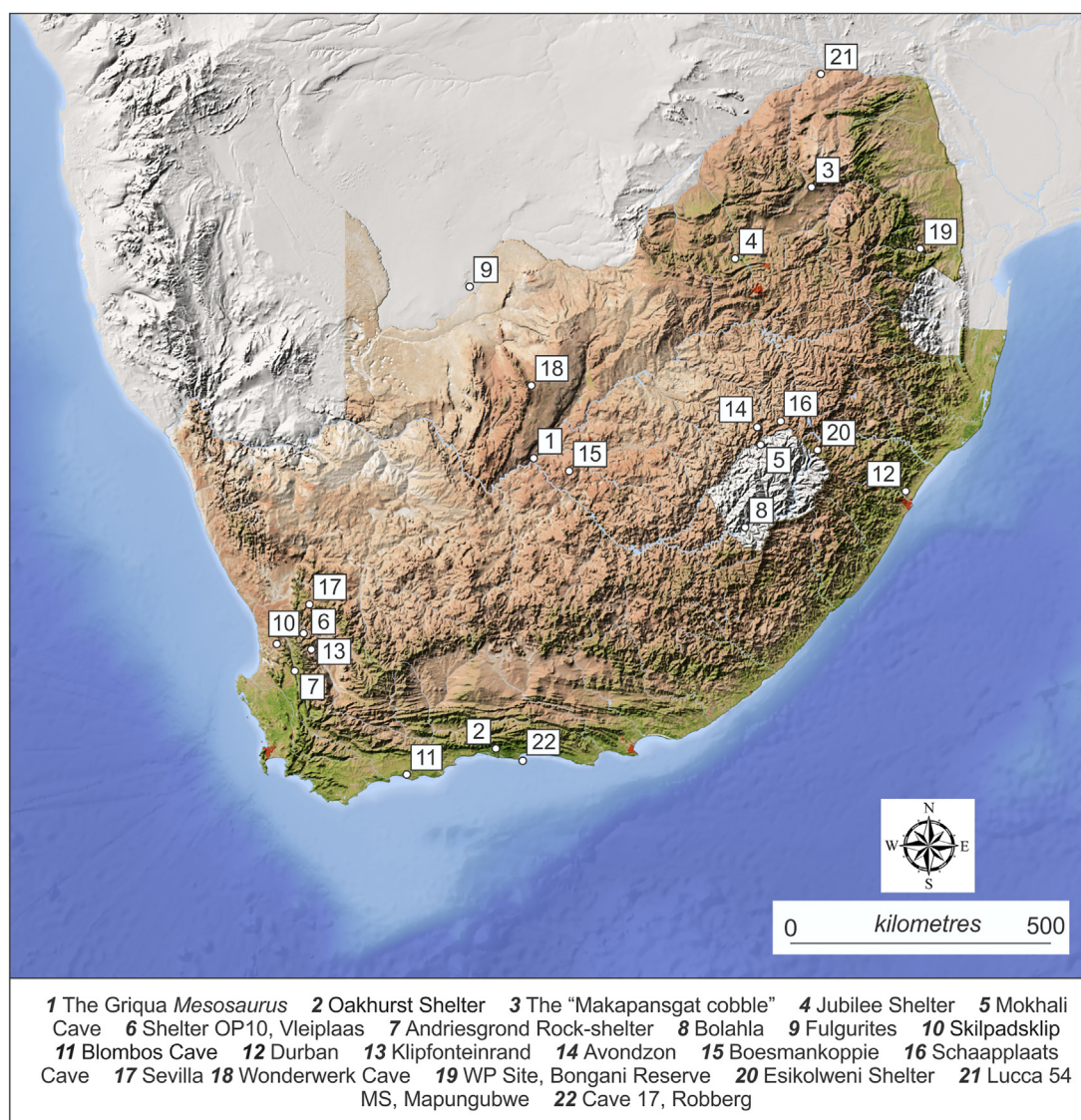


Fig. 1. Map of southern Africa, showing sites mentioned in the text. Map source: www.canstockphoto.com; ©MSchmeling – Can Stock Photo Inc.

3. Results

3.1. Previously reported sites in chronological order

3.1.1. The Griqua *Mesosaurus* (1865)

Paul Gervais (1865a,b), a French palaeontologist, reported on first seeing a fossil specimen in the collection of Edouard Verreaux (likely at the famous Maison Verreaux, in Paris) more than 20 years earlier. The specimen had been collected by Verreaux’s brother, Alexis, who had found it in the hut of a Griqua; it was reported as having been used as a pot lid. The Verreaux brothers had visited the territory of the Griqua, in the area surrounding the confluence of the Orange River and the Vaal River, in 1830–1831 (Parsons, 2002; Parsons and Segobye, 2009). The original discoverer is not credited by Gervais (1865a), and his or her name remains unknown.

Edouard Verreaux established Maison Verreaux in 1834, after he came back to Paris from Asia (Glen and Germishuizen, 2010). It is thus likely that Gervais first saw the specimen at Maison Verreaux sometimes in the late 1830s (which is consistent with his published statements of 1865).

Gervais’ (1865a,b) descriptions of this specimen led to it being the holotype for *Mesosaurus tenuidens*, a Permian reptile which would later prove crucial to the elaboration of the theory of continental drift (Oelofsen and Araujo, 1987). In southern Africa *Mesosaurus* has only been described from the Permian Whitehill Formation (270–280 Ma) which is exposed in this area near Kimberley and Hopetown (Baiyegunhi et al., 2017).

MacRae (1999) summarized the importance of this specimen in the introduction to his book on the fossils of South Africa. He suggested that the Griqua hut was situated near present-day Kimberley, and indicated that the specimen is housed in the National Museum of Natural History in Paris, France (Fig. 2, collection number MNHN 1865–77). He noted that the fossil consisted of a small, well-preserved skeleton on a flat shale slab.

The first formal description of a Karoo reptile followed an 1827 discovery near Beaufort West (Grisbrook, 1830b). The Griqua’s *Mesosaurus*, already being reportedly used as a pot lid in 1830–31, could very well predate this discovery. This site differs from the others we describe, in that some Griqua ancestry includes intermarriage with European colonists, and is therefore not exclusively ‘non-western’ (Morris, 1997; Balson, 2007). The oral



Fig. 2. The holotype for *Mesosaurus tenuidens*; scale in cm (image courtesy of Philippe Loubry - CNRS/MNHN).

tradition of non-western populations of southern Africa has left minimal written records of contemporary fossil discoveries and how they were interpreted, and no indigenous interpretation of the significance of this fossil was recorded.

3.1.2. Oakhurst Shelter, Wilderness, Cape south coast (1938)

The Oakhurst Shelter lies within the Wilderness Section of the Garden Route National Park, about 15 km east of George. Its deposits were excavated over the course of six field seasons from 1932 to 1935 (Goodwin, 1938). It has become renowned for the number of human burials (40 Khoisan) and the richness of associated material (Shepherd, 2015).

In describing the Later Stone Age (LSA) burial site of what he considered were probably young twins, Goodwin (1938, p. 253) reported that:

“in the left orbit of Skeleton IX was found a large broken crystal, roughly an inch in diameter, and with a diamond facet as large as an eye and correctly placed.”

Lewis-Williams and Pearce (2004, p. 63) recognized the profound importance of this report, noting:

“Perhaps the most suggestive of all the southern Cape grave goods comes from a burial of ‘twin’ infants aged between three and a half and four years at Oakhurst Cave. Touchingly, the two children lay side by side, the left arm of one across the shoulder of the other, as if in an embrace. A large, broken quartz crystal with the faceted end exposed was wedged in the left eye socket of one of the children.”

They rebutted doubts that had been expressed on whether or not the crystal had been intentionally placed in the orbit. They noted that at least the crystal must have been transported into the cave, and argued that the orientation of its faceted surface strongly suggested that it had been placed intentionally.

Lewis-Williams and Pearce (2004) and Hampson (2013) have noted the association between quartz crystals and shamans, and how the glitter of such crystals may be associated with the only part of the human body that likewise glitters, the moist eye. Lewis-Williams and Pearce (2004, p. 65) asked: “Was the ‘sight’ of seers



Fig. 3. The Makapansgat cobble; scale bar = 7 cm (image courtesy of Bernhard Zipfel - ESI, University of the Witwatersrand).

linked to the dead child in ways that we do not fully understand? Very possibly it was.”

They noted the obvious tragedy of the simultaneous deaths of two young children, and suggested that special precautions such as the placement of the quartz crystal were perhaps needed in the wake of such an unfortunate event.

3.1.3. The ‘Makapansgat cobble’, Limpopo Province, South Africa (1958)

Makapansgat, in the Makapan Valley, situated north-east of Mokopane in Limpopo Province, forms part of the Cradle of Humankind World Heritage Site (Berger and Hilton-Barber, 2006). A 260 g reddish-brown jasperite cobble excavated at Makapansgat in 1925, first reported by Eitzman (1958) and described in further detail by Dart (1974), is the oldest known manuport, having been transported at least several kilometres (Fig. 3). It was found in a cave in *Australopithecus*-bearing deposits, which have been dated to 2.95 Ma (McFadden, 1980). Detailed microscopic study of its surface markings was performed by Bednarik (1998).

The distinctive markings of the cobble, resulting from natural wear, result in a resemblance to a hominid face. The inference has been that an australopithecine (or early representative of *Homo*) may have appreciated the likeness to a face and the red colour, and transported it to the cave, in what would be the earliest known instance of symbolic thinking, apperceptive capability and self-awareness (Bednarik, 2013).

3.1.4. Jubilee Shelter, Magaliesberg, South Africa (1989)

Wadley (1989) described a collection of quartz crystals from a LSA hearth in Jubilee Shelter (Turner, 1986; Wadley, 1986) in the Magaliesberg, along with other items that might have been “shaman’s paraphernalia”.

3.1.5. Mokhali Cave, Lesotho (1990)

The three-generation Ellenberger missionary dynasty is indelibly associated with early scientific and ethnographic study in Lesotho. Victor Ellenberger made copies of paintings at over 400 rock art sites, with the help of his son Paul, who would go on to become a renowned ichnologist (e.g. Ellenberger, 1974). In 1930, when Paul Ellenberger was 12 years old, he visited Mokhali Cave (Fig. 4), near Leribe (Hlotse), with his father and the missionary artist Christol. While Christol sketched the cave, Paul made a tracing of four red ochre paintings that the group interpreted as a dinosaur footprint surrounded by images of three imagined trackmakers. Buttressing their claims, that the images represented prehistoric creatures, were dinosaur skeletal material in a rock near the cave and dinosaur trackways in the valley below.

Ellenberger preserved the tracings, first in Lesotho and then in Montpellier, France. In 1989 David Mossman, a Canadian palaeontologist on sabbatical in France, met Ellenberger and learned about them, briefly mentioning this in a book review in *Ichnos* (Mossman, 1990, p. 151):

“I was astounded to learn recently from Paul Ellenberger (Professor Emeritus, Universite des Sciences et Techniques du Languedoc) that in a region of profuse dinosaur tracks in Lesotho, the Bushmen left cave paintings illustrating dinosaur footprints, and in some instances also the presumed trackmakers. One of the creatures portrayed by those most superb of all trackers is the distinct outline of an iguanodontid, in bipedal stance, with reduced forelimbs and other details remarkably compatible with our present-day enlightened understanding of those ancient creatures.”

Mayor and Sarjeant (2001, p. 151) referred to this as a lone southern African example in their discussion of the folklore of fossil footprints:

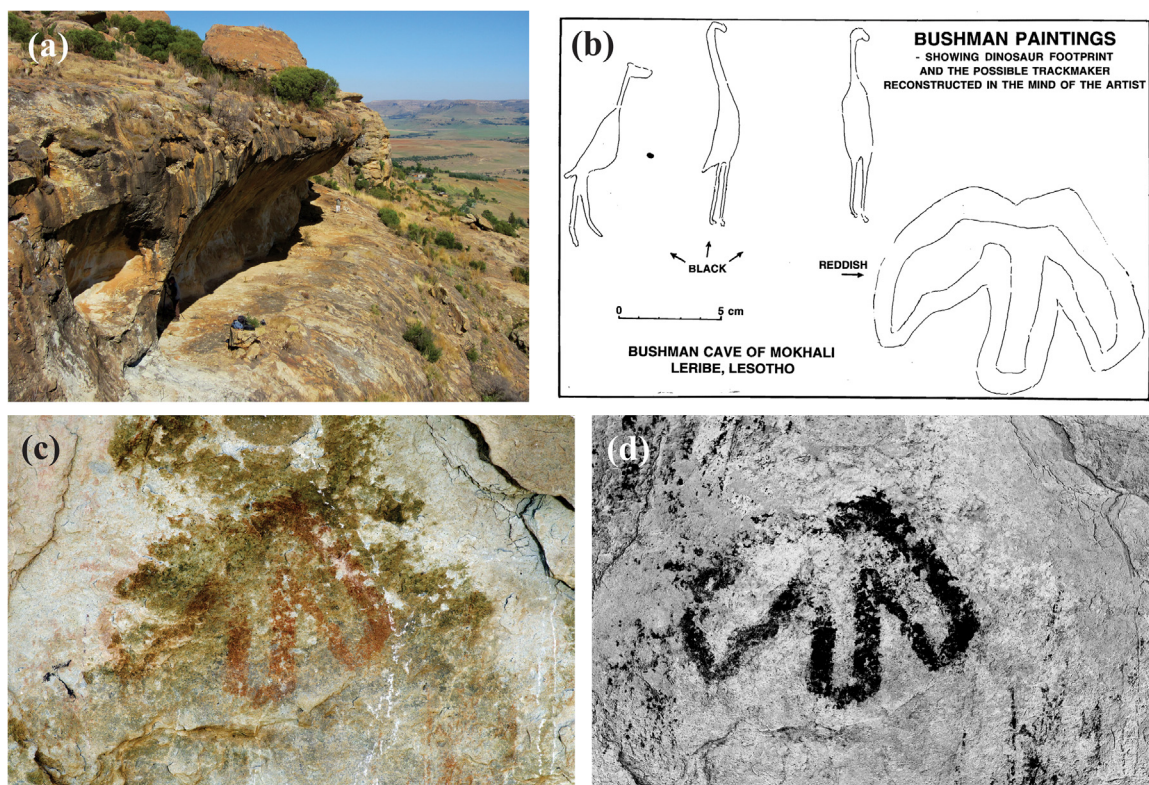


Fig. 4. a) Mokhali Cave; b) Rock art of tracks and trackmakers from Mokhali Cave, after 1930 tracing by P. Ellenberger (courtesy of David Mossman), scale bar = 5 cm; c) The Mokhali Cave dinosaur footprint in natural light; d) The Mokhali Cave dinosaur footprint after applying the CPED Toolset (image courtesy of Kevin Crause).

"In southern Africa . . . anthropologist Paul Ellenberger discovered that, in a region of Lesotho where dinosaur tracks were abundant, the Bushmen had depicted in cave paintings not only the footprints but also their conception of the creatures that made them. Ellenberger reported that some of their reconstructions are remarkable likenesses of iguanodonts; even the forefeet are in correctly reduced proportions to the body."

In 2004 Mossman visited South Africa with his son Alexander, and located Mokhali Cave after a two-day search. The footprint image was just discernible, but the track-maker images were not evident. Then, seventy-five years after the tracing was made, an article by Ellenberger, the Mossmans and ichnologist Martin Lockley was published in *Ichnos* (Ellenberger et al., 2005).

Their conclusions were bold (Ellenberger et al., 2005, pp. 224–226).

"An example of artistic realism, the painting of the footprint is of the same coloration as the Lower Jurassic redbeds. The painting, in red ochre, is reasonably well preserved and will be readily recognized by vertebrate paleoichnologists as belonging to an ornithopod."

They noted that proportions were fairly typical of ornithopod tracks (which tend to be wider than they are long), and that the drawing probably predated the earliest published account of a dinosaur track. Turning to the track-maker images, they continued:

"Beside the footprint, representations of three bipeds resembling ornithopods are outlined in black. The forms of the three figures are particularly revealing as they evidently show us how the Bushmen reconstructed the trackmaker from the footprint record. First and most striking is the upright bipedal stance. This shows astute perception on the part of these Paleolithic artists."

Citing Sarjeant (1997b) they continued:

"The reconstruction can be compared with the cumbersome and unconvincing model of a quadrupedal ornithopod (iguanodont) assembled for public display at Crystal Palace in London by Sir Richard Owen in the latter half of the 19th century."

They attributed the lack of forefeet and tails in the images to the rarity of impressions of these body parts in the Lesotho trackway record, and observed that the artist viewed the trackmakers as large bird-like creatures, closer to the mark than the observations of Hitchcock (1836, 1845). They noted the presence of a small dinosaur skeleton at the eastern end of Mokhali Cave, and that it had small arms and no visible tail. They thus contended that "the artistic portrayals represent a remarkably modern or realistic view of dinosaurs as elegant, erect, bird-like creatures, which contrasts with the rather sluggish, tail-dragging animals depicted in most western scientific literature until the early 1960s."

They then drew on Bleek's ethnographic studies of the San (Bleek and Lloyd, 1911):

" . . . the Bushmen were greatly intrigued by the ancient times preceding the existence of men . . . The prehistoric Bushmen sang about the early times, and about the monsters that made the huge beast-footed trackways in the red rock. Petrified bones of dinosaurs, so numerous in Lesotho, made a big impression on them. Drawing on Bushmen mythology, a giant creature known as //Khwai-hemm was on ceremonial occasions fabricated to represent in character and appearance the dreaded 'All-devourer.' One ought not be astonished that these grand connoisseurs of nature were interested and knowledgeable about dinosaurs. They would have had vivid impressions of giant footprints left by wandering dinosaurs . . . they knew instinctively that the fossilized tracks were real and must have represented once living animals, even though extant relatives were not observed making tracks. There was, then, an authentic Bushmen paleontology—the

lethal prehistoric monster //Khwai-hemm (named Kholumolumo by the Sotho) had held primacy over all the creatures which were living on earth during the far old beginnings. The only things now visible are its tracks, or bones transformed into stone. By carefully observing the various Jurassic tracks the artist could reconstruct pictures of specific trackmakers, in effect bringing //Khwai-hemm and contemporary creatures back to life. The resulting delicate pictorial record, and the surviving songs and stories about dinosaur footprints and their makers, illustrate the perspicacity and genius of Bushmen trackers, hunters, and artists."

One of us (C.H.) became aware of these publications, and visited Mokhali Cave with Crause in 2011. Emerging technology (the CPED toolset) was used to evaluate the images, yielding enhanced digital recordings (Helm et al., 2012; Helm, 2013). The footprint image that this technology provided was compelling, but it was evident that the 'trackmaker images' had forever disappeared.

3.1.6. Shelter OP10, Vleiplaas, Cederberg, South Africa (1990)

Miller et al. (1990) described how a student, Ursula Evans, found a trilobite in a run-off channel on the sandy floor of a passageway near a rock-shelter (OP10) with rock art on the farm Vleiplaas in the Agterpakhuis area of the northern Cederberg. They noted further (Miller et al., 1990, p. 3):

"In the driplines of rockshelters in the western Cape Province one frequently finds shiny weathered pebbles of haematite (a reddish iron oxide) and pyrolusite (a black manganese oxide), presumably collected by early inhabitants. These pebbles could have been crushed or scraped for pigment, or collected and kept intact because they were attractive in their own right. More rarely one finds whole clear quartz crystals, relatively undamaged and showing bright natural facets. These were most certainly collected from where they occur sporadically in the surrounding sandstone terrain and brought to the shelters to be kept there."

The trilobite was accompanied by quartz crystals and such haematite and pyrolusite fragments, as well as stone tools. It occurred in a lenticular nodule, and was identified by Miller et al. (1990) as an enrolled juvenile of *Burmeisteria herscheli* (Murchison, 1839), from the proportions of the thoracic segments and the position of the tubercles on both axis and pleurae. This species is commonly encountered in the Lower-to-Middle Devonian Bokkeveld Group. It was removed, and accessioned at the Council for Geoscience in Bellville, Cape Town (Fig. 5, collection number B 472).

Shelter OP10 occurs in Table Mountain Group (TMG) rocks, which are much older than the nearby shales of the Bokkeveld



Fig. 5. The specimen of the trilobite *Burmeisteria herscheli*, recovered from Shelter OP10, Vleiplaas (image courtesy of John Almond).

Group. The nearest outcrops of Bokkeveld Group deposits were noted to be ten km to the north and the east. The authors concluded:

"We believe that the fossil was recognised as something special and collected for this reason, and may have been stored along with the quartz crystals and pigment nodules... As far as we know, this fossil is unique in a Later Stone Age context in the southwestern Cape Province... We now have intriguing evidence that these fossils... attracted the attention of indigenous people in pre-colonial times."

Macrae (1999, pp. 2–3) accorded exceptional status to this discovery, describing it on the first two pages of his book on the fossils of South Africa:

"There is an interesting record from South Africa of Late Stone Age... interest in fossils, where they were probably used for ornamental or magical purposes."

Four South African archaeologists, led by Duncan Miller, published an account documenting a Late Stone Age... interest in fossils. While on a rock-art study trip in the northern Cederberg... they came across a fossil of a rolled up trilobite on a level which was once inhabited by Stone-Age Man. They pointed out that it could not possibly have been weathered out of the Table Mountain Sandstone, the rock type in which the shelter is formed... This fossil... was most probably regarded as a special object, used either for ornamental or magical purposes."

3.1.7. Andriesgrond Rock-shelter, Olifants River valley, South Africa (1990)

Miller (1990) mentioned a personal communication from G. Anderson indicating a group of five quartz crystals that had been excavated (LSA) from the Andriesgrond Rock-shelter in the Olifants River valley (Orton and Mackay, 2008).

3.1.8. Bolahla, Lesotho (1997)

Archaeo-zoologist Ina Plug indicated that in her analysis of the fauna (Late Pleistocene and Holocene) from deposits in the Bolahla cave in southern Lesotho (Mitchell et al., 1994), she had identified a terminal phalanx of a large vertebrate, possibly belonging to the Early Jurassic prosauropod dinosaur *Massospondylus* (Plug, 1997). She hypothesised that the fossil must have come from the Karoo sediments and noted that there was no evidence that it had eroded out of the walls or roof of the shelter. She concluded that it must have had curiosity value that led to someone taking it home.

She noted also the use in Iron Age and recent times of bovid phalangeal bones as ornaments and playthings, or by diviners. The Bolahla phalanx was reported by Helm (2013).

3.1.9. Fulgurites, Kalahari (1999)

Lorna Marshall (1999) spent field seasons in the early 1950s with the San in the Kalahari Desert. Her reporting of the rites of the

!Kung documented that fulgurites were used in rain-making rituals. Fulgurites are natural tubes of glass formed by the fusion of sand (usually silica in the form of quartz grains) from lightning strikes. They were referred to by !Kung as 'rain teeth' or 'lightning teeth'. They were encountered most frequently beneath trees that had been struck by lightning. The fulgurite would be splintered, added to plant material, and placed in a rain horn, which Marshall described as a "vestige of rainmaking procedure that must have come from the distant past" (Marshall, 1999, p. 166; Hampson, 2013). The rain horn could be used to call either rain or lightning. A mixture of 'lightning teeth' and the red heartwood of the /ana tree (*Acacia albidia*) could also be taken from the rain horn and used to anoint people in order to protect them from lightning.

3.1.10. Skilpadsklip, Graafwater, South Africa (1999)

Braddy and Almond (1999, p. 167) report the place name 'Skilpadsklip' for a low hillside exposure south of Graafwater (Western Cape Province, South Africa) containing bedding planes covered with large arthropod trackways: "These traces have long been known to the local people, who referred to the locality as Skilpadsklip ('tortoise rock'), alluding to the supposed reptilian track makers." How far back in time the oral history associated with this place name extends is not clear. The site therefore cannot be classified as 'pre-western' with confidence. Nonetheless, it represents an example of sufficient local awareness of fossil trackways to justify naming a feature after them.

3.1.11. Engravings in ochre, Blombos Cave, South Africa

Bednarik (2009, 2013) provided numerous examples from southern Africa of Early Stone Age and Middle Stone Age (MSA) evidence of pigment use, and art on rocks that had been carried into caves (e.g. Apollo 11 Cave). We acknowledge that any such rock or ore that was 'mined' in one area and transported for utilitarian or symbolic use (including human adornment or rock art) meets the definition of a manuport. However, for the purposes of this discussion, we focus on a well-known example in southern Africa of such art mobilier: the MSA engraved red ochres of Blombos Cave. The cave is situated 35 m above sea level on the Cape south coast 300 km east of Cape Town in the Western Cape Province.

Henshilwood et al. (2002) first drew attention to two such works, dated to 77 ka, which were distinguished by cross-hatching and parallel lines, and inferred that they supported the emergence of modern human behavior in Africa at least 35,000 years before the oldest-known similar examples from Eurasia. The larger piece measured over 7 cm in maximum length and over 3 cm in maximum width (Fig. 6). They concluded that these engravings were intentional images and that in southern Africa *Homo sapiens* was behaviorally modern about 77,000 years ago.

Henshilwood et al. (2009) reported on 13 additional probable engraved pieces of ochre from Blombos Cave, in the 75–100 ka age



Fig. 6. Engraved ochre from Blombos Cave (image courtesy of Prof. Christopher Henshilwood).

range. They noted that the closest currently exposed outcrops of ochre are situated 19 and 21 km from Blombos Cave, but that outcrops 3–5 km away could have been exposed during Pleistocene marine regressions.

Claims of deliberately engraved ochre need to be distinguished from the striations that occur when ochre is ground or scraped to produce a powder which may have been used as a pigment, and possibly for its chemical composition as a hide tanning agent, sunscreen or in hafting adhesives (Wadley et al., 2009; Hodgskiss, 2010; Rifkin, 2011; Rifkin et al., 2015). Engraved ochre pieces are found at other MSA sites in South Africa (Mackay and Welz, 2008; d'Errico et al., 2012; Hodgskiss, 2013; Hodgskiss and Wadley, 2017). Thackeray (2005, 2013) has suggested that engraved lines could represent symbolic wounds, in particular when they allow the bright red colour of the ochre to be exposed. Such speculation provides a possible motive for the transportation of red ochre pieces to rock shelters for purposes of engraving.

3.1.12. Durban, Kwazulu-Natal Province, South Africa (2004)

Lewis-Williams and Pearce (2004) described a finely worked 4 cm-long point fashioned from a single large quartz crystal collected by Lewis-Williams at a LSA red-dune site 10 km north of Durban in the 1970s (Fig. 7). They suggested that it was too fragile for use as a spear or arrow point, and that it seemed to represent a ritual application of spiritual sight. The point was recovered just prior to the site being bulldozed, hence no further context could be recorded.

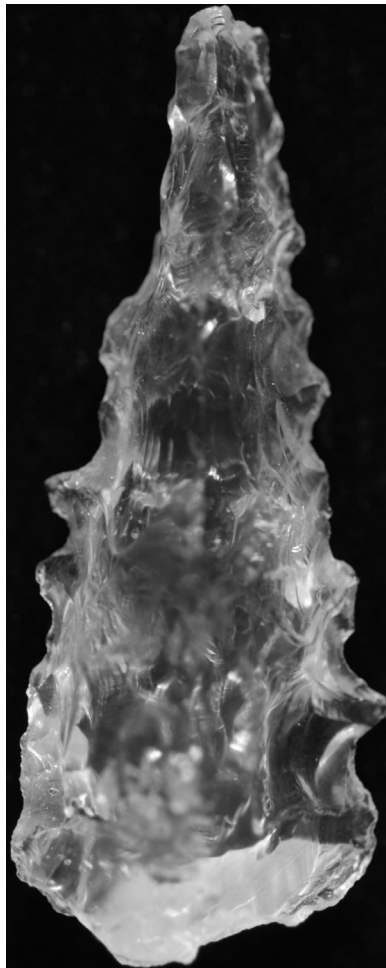


Fig. 7. Finely worked 4 cm-long point fashioned from a single large quartz crystal from 10 km north of Durban (image courtesy of David Pearce).

3.1.13. Klipfonteinrand, Cederberg, South Africa (2012)

Mackay (2012, p.8) reported on a trilobite (Fig. 8) found in MSA deposits in the Klipfonteinrand rock shelter, a large, east-facing rock shelter site situated in a ridge of Table Mountain Group quartzites in the eastern Cederberg:

“Typical Howiesons Poort markers were found in Squares 2 and 6, indicating a probable age of 60–65 ka, and below these, artefacts of early MSA association probably >75 ka. While artefacts were abundant in these deposits, classes of finds other than stone artefacts and ochre were largely absent. An interesting exception is a probable trilobite fossil recovered in proximity to Howiesons Poort artefacts in Sq 2.”

The trilobite fossil was identified as a complete *Burmeisteria* sp. by John Almond, and was repositated at the University of Cape Town. The nearest outcrop of the Gydo Formation (the probable source of the trilobite) occurs 400 m from the Klipfonteinrand shelter. It is just conceivable, albeit unlikely, that the specimen was collected from down-wasted gravels overlying the Table Mountain Group closer to the shelter. Nonetheless, it had to have been transported into the shelter.

3.1.14. Avondzon, eastern Free State, South Africa (2013)

A hill on Avondzon farm, north of Fouriesburg, contains multiple rock art sites in the Clarens Formation. Near the centre of the easternmost shelter, towards the back wall, a large rock was noted to have fallen from the ceiling, displaying dinosaur bones. Further bones were evident on the ceiling. Whereas the remainder of this and the adjoining shelter were sparsely endowed with rock art, a zone of concentration of paintings was evident 75 cm from the bones on the nearest suitable flat surface (Fig. 9). This site was brought to Helm's attention by Sven Ouzman, and its existence was reported in Helm (2013).

3.1.15. Boesmankoppie, Northern Cape, South Africa (2013)

Boesmankoppie is a dolerite hill within Mokala National Park, west of Kimberley. Tours are conducted to the site by SANParks. Rock engravings have been made on dolerite boulders near the summit (Morris, 2007). These petroglyphs create a colour effect, exposing reddish rock beneath the weathered black surface. They include two human figures, a variety of other mammals, ostriches and monitor lizards. One tridactyl, narrow-toed engraving resembles the track of a giant bird or theropod dinosaur (Fig. 10). Many large birds produce an anisodactyl track (including the backward-pointing first digit), whereas theropods typically exhibit tracks with only three forward-pointing toes. There is no evidence of a backward-pointing toe in this engraving. The digits are approximately 15 cm long. The other engravings at the site are significantly smaller than their real-life counterparts. Helm (2013) concluded that the engraving may have been a depiction of the track of a large prehistoric or mythical creature.

3.1.16. Schaapplaats Cave, eastern Free State, South Africa (2013)

The Schaapplaats cave, near Clarens, was declared a South African National Monument in 1934, and a fence has been erected to protect the rock art (Deacon, 1993; Lewis-Williams and Blundell, 1998; Ouzman, 2000; Smith, 2003). The three main rock art image clusters on the rear wall of a richly decorated rock-shelter appear spatially associated with dinosaur tracks, as reported by Helm (2013) after the site was brought to his attention by Sven Ouzman. In one instance a block which had fallen from the ceiling harboured a dinosaur trackway comprising two pes impressions (length 9 cm, width 5.5 cm, pace length 42 cm). No manus impressions were evident. This narrow tridactyl trackway in the Clarens formation (early Jurassic) was probably made by a small theropod such as *Lesothosaurus*. The two tracks led to a panel of at least five eland

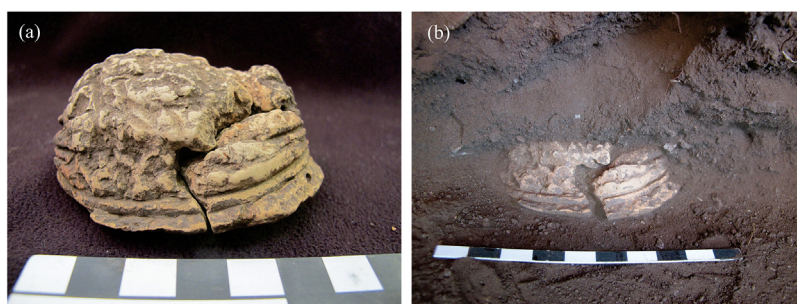


Fig. 8. a) *Burmeisteria* sp. trilobite manuport found in Klipfonteinrand rock shelter; b) the Klipfonteinrand trilobite manuport in deposits of at least 60 ka; scale bars in cm (images courtesy of Alex Mackay).



Fig. 9. a) Author C.W.H. beside dinosaur skeletal material and in front of rock art, in shelter at Avondzon (image courtesy of Penelope Noall); b) detail of skeletal material in a), scale bar = 10 cm.

images (Fig. 11). In order to produce the paintings the artist(s) would have had to crouch or kneel on the dinosaur trackway. In these conditions, there is little chance that the artist(s) did not notice the fossil footprints (Helm, 2013).

In the second instance a large (length > 30 cm; width > 30 cm), blunt-toed natural cast of a dinosaur track was noted toward the centre of the ceiling of the shelter. This track was the best-preserved in a probable trackway comprising three tracks. A large therianthrope panel and rhebok hunt panel were situated on the rear wall, directly into the shelter from this natural cast. In the third instance a probable medium-sized theropod track (tridactyl, narrow-toed, with track length greater than track width) was noted on the ceiling towards the upstream end of the shelter. On the rear wall directly behind this track a panel (known as ‘the enigma’) was composed of two orange paintings, one of which was an eland. Above one of these were two bright red paintings. The lower red figure lent itself to possible dinosaur interpretations.

3.1.17. Sevilla, Cederberg, South Africa (2013)

Sevilla farm in the northern Cederberg boasts multiple galleries of LSA San rock art. Information and images provided by Kevin Crause (pers. comm., 2012) indicated that one such gallery contained two quadrupedal, tailless, long-necked animal figures, one of which had a gaping mouth (Fig. 12). These images did not resemble any extant creatures. Whereas the San further to the east would have mostly encountered Triassic and Jurassic dinosaur trackways and bones, their counterparts in the Karoo would have been likely to come across trackways and bones of Permian tetrapods. Some ichnologists (e.g. Schad, 1977; Lockley, 1999; Riegner, 1998) in examining animal morphology and the relationship between a creature’s appearance and habits and its tracks, infer that tracks and trackways provide information on the whole

animal. “In the study of tracks, the narrowness or breadth of a foot, hand or body is expressed in coherent biological relationships throughout the body of individuals or species” (Lockley, 1999, p. 49). Given that the San were among the finest trackers, apparently able to interpret the characteristics of a trackmaker from its prints alone, they are cited by Lockley: “[the] Bushmen, who somehow possessed a form of holistic consciousness that allowed them to correlate tracks with animals with such consistency that observers claim they were never wrong.” From this ichnological perspective, paintings in the Sevilla panel are what one might expect from an informed study of the tracks of a Permian parareptile (pers. comm. Martin Lockley, 2012). Alternatively, if such paintings relate to trance experiences of beasts encountered in the spirit world, such a vision may have been related to a prior awareness and interpretation of fossil tracks and bones. The nearest suitable rock exposures (of the Beaufort Group) are approximately 75 km from Sevilla.

3.1.18. Wonderwerk Cave, Northern Cape, South Africa (2013)

Wonderwerk Cave is situated between Kuruman and Danielskuil in the Northern Cape Province, and is a National Heritage Site. It is justly renowned for its evidence of early controlled use of fire (Beaumont, 2011; Berna et al., 2012), manuports indicating pigment use extending through multiple levels (e.g. Beaumont, 1990, 1999; Bednarik, 1994), and engravings in art mobilier (Beaumont and Vogel, 2006; Bednarik and Beaumont, 2012).

While these phenomena are of great interest, they are not part of the focus of our review. However, Bednarik (2013) also noted clusters of small water-worn pebbles and quartz crystals in Wonderwerk Cave, which he indicated had to have been collected a considerable distance from the site. These pebbles and crystals were found in the Fauresmith levels of the cave, dated at 276–500 ka.



Fig. 10. Tridactyl rock engraving, outlined by dotted line, on dolerite boulder at Boesmankoppie, scale (pen) = 15 cm.



Fig. 11. Arrows indicate theropod trackway at Schaapplaats – images resembling eland are visible on the rock wall behind the tracks.



Fig. 12. Rock art at Sevilla after application of the CPED Toolset (image courtesy of Kevin Crause).

3.1.19. WP Site, Bongani Reserve, Mpumalanga, South Africa (2013)

Hampson (2013, 2016) reported what appears to be a unique phenomenon near the south-western corner of the Kruger National Park, at rock art site WP, which featured a surface containing twelve human figures and three large red patches. Emanating from one of these patches was a red line, painted on a quartz vein that ran parallel to a ledge on the surface.

Hampson (2013) noted the relevance of quartz veins, and that in many hunter-gatherer worldviews, quartz was considered to be potent and alive. Referring to the work of Lewis-Williams et al. (2000); Hampson (2013, p. 368) noted:

“red lines, often fringed with white dots, are common in San rock art; they depict the ‘threads of light’ that trance dancers routinely report seeing and that lead them into the spirit realm. The quartz vein is therefore linked to transition between realms by the addition of the painted ‘thread of light’.”

Hampson suggested that the juxtaposition of the patch of paint beside the quartz vein, and the painting of the red line on the vein were not accidental, and that *“both paint and quartz were considered powerful”*. He suggested that *“a ritual specialist harnessed the inherent power in the quartz vein to facilitate entrance into and exit from the spirit*

world that he or she believed lay behind the rock face.”

3.1.20. Esikolweni Shelter, Drakensberg, South Africa (2015)

Esikolweni, a 160 m long rock-shelter at the base of the Clarens sandstone in the Cathedral Peak area, contains impressive rock art (Rossouw and Mbatha, 2015) and an articulated, nearly intact *Massospondylus* skeleton (Chapelle, 2017). The skeletal remains are on a loose, fallen rock in front of the shelter. However, personal communications by the research team from University of the Witwatersrand (Jonah Choiniere, 2017) and Amafa / Heritage KwaZulu-Natal (Sonja Krueger, Celeste Roussouw, 2018) suspect that the creation of the rock art may have predated the more recent exposure of the skeletal material, which was discovered in about 2002 by Meredith Pfotenbauer following a rock-fall. It is therefore not known whether or not the skeleton had been visible to non-western cultures in the ceiling of the shelter prior to the rock-fall. The age for the San art at this site is not known, but an average for San art in the Drakensberg has been established of 3 000 years BP to 200 years BP. The image clarity suggests a date towards the younger end of this range. Late White Paintings at the site can be dated to a maximum of 700 years BP; again, the clarity of the art suggests a younger date (Rossouw and Mbatha, 2015).

3.1.21. Lucca 54 MS, Mapungubwe, South Africa (undated)

According to the catalogue of the collections of the Archaeological Department at the University of the Witwatersrand, the archaeological site AD 407 site located on farm Lucca 54 MS in the Mapungubwe area has delivered “dinosaur bones” accompanied by a chopper, roughly dated from the Middle or Early Stone Age. Unfortunately, despite careful investigations kindly conducted by the curator Thembiwe Russell, the specimens could not be located and appear to be lost. Therefore the identification of dinosaur bones cannot be confirmed, although dinosaur bones have been found elsewhere in the Mapungubwe National Park in outcrops of the Clarens Formation outcrops (Henning and Beater, 2014). These bones thus likely represent short distance manuports.

3.2. Cave 17, Robberg – a new geomythology site in South Africa

In 2017, following promotion of our geomythology interest in various presentations and conversations, we became aware of a new geomythology site in the Robberg Nature Reserve (managed by CapeNature) on the Cape south coast, west of Plettenberg Bay.

Goodwin (1946) had noted the importance of archaeological deposits in this area, including bone tools and painted grave-stones. Rudner (1971) reported that eighteen of these painted stones were repositied at the South African Museum. Rudner and Rudner (1974) described the early archaeological work, beginning in 1880, which had been done in caves on the Robberg peninsula, resulting in a collection of 48 human skeletons in the Iziko (South African) Museum. Within Rudner's article a map provides locations and numbers for the Robberg caves. ‘Cave 17’ corresponds to the site we describe, and we have therefore chosen to use the term, as it represents the first description of this cave shelter. In Rudner's accompanying table Cave 17 is described as being a small shelter with a shell midden.

Indeed, it was the extensive shell midden, spilling down the sandy, bushy slope onto the main hiking trail which led to the discovery in 2013 by Mr. Guy Thesen of a trilobite fossil on the surface of the floor of Cave 17. Cave 17 is approximately 10 m long and 1–6 m deep, and 35 m above sea level. It commands an expansive view of Plettenberg Bay, the Tsitsikamma coastline, and the Tsitsikamma Mountains on the horizon.

Plettenberg Bay is one of a series of eastward-opening headland bays of the Cape south coast. It has a log-spiral form and developed in the lee of the Robberg Peninsula, which defines the southern boundary. The Robberg area mainly comprises rocks from three distinct time periods: Palaeozoic rocks of the Cape Supergroup, Mesozoic rocks of the Robberg Formation (quartzitic sandstones of the Early Cretaceous Robberg Formation and younger Cretaceous conglomerates), and Late Pleistocene aeolianites (Toerien, 1979; Reddering, 1983). The Robberg Formation is the lowermost unit of the Uitenhage Group and consists of sandstone, subordinate conglomerate and breccia, reaching a maximum thickness of 95 m (Reddering, 1983). The overlying Enon Formation comprises reddish-brown to orange-yellow conglomerate with infrequent interbedded sandstone and mudstone (Shone, 2006). Clasts are derived from the arenaceous Table Mountain Group in the surrounding areas north of the Gamtoos Basin. The shoreline around much of the peninsula is rocky, with scattered deposits of Pleistocene calcarenite.

The incision of ‘Cave 17’ has not taken place along a bedding plane or geological contact, but this near vertically-oriented shelter formed as a result of a sizeable block of rock (20 m in height and 15 m in width) dislodging from the cliff side. The stratigraphy on this shelter wall is composed of Robberg Formation quartzite at the base, overlain by Enon Formation conglomerate. The orientation of the plane of weakness which was responsible for the offset in the outcrop and the eventual development of this shelter trends at an orientation of 280/100°.

A surface survey of Cave 17 yielded archaeological material in scattered finds, suggesting a recurrent MSA and LSA occupation, dating from a few hundred years to more than 40,000 ka. A surface survey was undertaken. The north-facing site has a slight overhang and a deep crevice to the right (west). Archaeological deposit is scattered on the surface along the entire extent. A large amount of shellfish deposit/midden lies below the cave on the talus slope, in thick vegetation.

From 40 – 20 ka sea level dropped, to a maximum lowstand depth of 130 m below present during the Last Glacial Maximum (e.g. Waelbroeck et al., 2002). During this time, the coastline retreated to a maximum distance of 12 km offshore of the Robberg Peninsula (Flemming et al., 1983). Conceivably the site could have been abandoned during this period.

Typical of the Robberg industry, the choice of raw material in the assemblage at the site is quartzite (Deacon and Brett, 1993). A variety of segments are present; bladelets, bladelet cores, and scrapers, of an average size (>40 mm), along with large flake blades and triangular flakes/blanks, 60–70 mm in length, pointing to a

timespan of Middle-Later Stone Age transition. The assemblage shows crude large flake blades and a low frequency of secondary retouched flakes. There are a number of small quartzite chips (<25 mm), found in concentrated patches of shellfish in the surface deposit, which may have facilitated hafting. Fragmented bone pieces are present of varying preservation; one fragment may have been worked. No ostrich egg shell fragments were found on the surface; however, it is possible that these may be found in the large midden on the talus slope. Pottery shards are absent, which is consistent with occupation dates of later MSA and early LSA. A few ochre pieces were scattered among the shell deposit on the surface. The presence of ochre pieces may conceivably be associated with the trilobite. A modern, well-advanced cognitive behaviour is implied. In all probability the site was frequented through occasional visits during the LSA, as this appears to be the pattern of occupation at other archaeological sites on the Robberg peninsula. Because the trilobite manuport was found on the surface, the possibility of it being of recent or historical age cannot be fully excluded.

The fragile trilobite, which is at risk of disintegrating, requires stabilization, and has been reported to CapeNature. The fossil measures 5 cm x 3 cm and is an external mould of a partially complete trilobite thorax belonging to *Bainella* (Rennie, 1930). The rock in which it was found is highly cleaved and measures a maximum length, width and height of 17 cm, 8 cm and 4 cm respectively, with a mass of ~ 600 g, making it easily portable (Fig. 13). This fossil specimen is most likely *B. africana* (Salter, 1856) or *B. gamkaensis* (Rennie, 1930), both of which are only known from the Emsian (Early Devonian) Gydo Formation of the Bokkeveld Group. Thoraxes of *B. africana* and *B. gamkaensis* are virtually identical and are diagnosed by having at least 11 segments, each comprising a medial axial ring bordered laterally on each side by a pleura. Axial rings, characteristically, are sagittally constricted (narrowed towards the midline) and surmounted by posteriorly directed axial spines on their dorsal surfaces.

The nearest exposures of the Gydo Formation occur at Keurboomstrand, a linear distance of 10 km from Cave 17 at Robberg, and a minimum walking distance (along the beach) of 18 km. Further nearby coastal exposures of the Gydo Formation are present at Salt River mouth near Nature's Valley (25 km northeast of Robberg).

4. Discussion

4.1. Comparison to similar sites on other continents

Lockley (1991), referring to dinosaur footprints, noted that in many places around the world, rock art is found right next to footprint-bearing outcrops. Two North American equivalents of

the Mokhali Cave footprint image are known. One occurs near Joseph City, Arizona (Mayor, 2005), where a petroglyph above a rock slab containing dinosaur tracks appears to be a schematic representation of such a track. The other is at Flag Point, Utah (Mayor, 2005; Lockley et al., 2006), where a painting resembling a theropod footprint adorns a cave wall just below dinosaur trackways. Lines of figures on either side appear to be facing the footprint image with arms raised, possibly in veneration. Thybony (2002) described the painting as 'instantly recognisable ... it clearly depicted one of the fossil tracks ... seen above ... it must be the oldest-known recording of a dinosaur footprint in North America'. In a further similarity, both the Mokhali Cave and the Flag Point images point downwards, in contrast to virtually all depictions of dinosaur tracks in the scientific literature. Tridactyl engravings similar to the petroglyph at Boesmanskop occur in Arizona and Wyoming, in areas that harbour dinosaur footprints (Mayor and Sarjeant, 2001).

A site in Poland has commonalities with the southern African Schaapplaats rock-shelter. Gierliński and Kowalski (2006) described a dinosaur track beside petroglyphs near Kontrewers, at a site of possible occult gatherings. They suggested (Gierliński and Kowalski, 2006, p. 219) that the petroglyphs "accentuated the mysterious, perhaps supernatural, character of the fossilised footprint". They acknowledge that the connection between the fossil and the art cannot be proven, but suggest that "the presence of fossil footprints might have inspired shamans to choose the site for sacred rock art, whatever the engraved images may represent".

Trilobites feature in European, Asian, North American and Australian pre-scientific history, including as petroglyphs (in Utah), as amulets with drill-holes (Parat, 1902), and in association with burials (e.g. Oakley, 1965; Mayor, 2004, 2005; Buffetaut, 2017).

4.2. Quartz

No fewer than six of the sites we have described are characterised by the presence of quartz crystals (Oakhurst Shelter, Jubilee Shelter, Shelter OP10 at Vleiplaas, Andriesgrond Rock-shelter, Wonderwerk Cave, Durban). Fulgurites and the WP site also represent forms of quartz. Furthermore, one of us (R.R.) reports a number of unpublished sites in the Western Cape Province of South Africa that harbour collections of quartz crystal manuports in rock art shelters, often placed in a crevice near the rock art imagery. We therefore review possible reasons for the frequency of this finding.

Hampson (2013) provided a detailed account of the importance of quartz and quartz crystals to indigenous cultures around the world, including its perceived potency and 'live' nature. According to Lewis-Williams and Pearce (2004) this importance may be



Fig. 13. a) and b) *Bainella* sp. trilobite from Cave 17 in the Robberg Nature Reserve, scale bar = 10 cm.

related in part to altered states of consciousness that may follow exposure to light refracted by crystals, and to properties of quartz that may trigger electrochemical responses in the brain. Furthermore, they note how the association of glittering crystals with the glitter of moist eyes has been connected with shamanistic sight, and the placement of a large quartz crystal in the orbit of a deceased child in the Oakhurst Shelter hints at an association between quartz crystals and sight. The intricate Durban quartz point, with the opinion for [Lewis-Williams and Pearce \(2004\)](#) that it was too fragile for use in hunting bolsters this argument.

In addition, there is the phenomenon of triboluminescence, whereby quartz crystals and quartz rocks, when scratched or rubbed against each other, generate a bright flash of light ([Dawson, 2010](#)). This would be especially impressive after dark, or in the dark recesses of a cave or rock shelter. Quartz crystals can also produce an electric voltage (piezo-electricity). These phenomena occur also when quartz breaks or is split. This light is interpreted as “spiritual power” ([Hampson, 2013](#)).

It therefore is not surprising that quartz crystals were collected by hunter gatherers and transported to shelters, nor that they were considered sacred and connected with spirituality. Quartz was also associated with hail and rain, and the possessors of quartz crystals might thus have been viewed as having acquired power over these elements.

4.3. Patterns in fossils, rocks and art

Rock art motifs in southern Africa may take the form of parallel lines, zig-zag patterns, chevron patterns, wavelike, sinuous or undulating lines which are sometimes nested, spiral forms and other geometric patterns. Parallel lines have been interpreted as power lines, as they often follow under or over mythical or power animals, like the eland and the elephant (being rain animals) and may visually connect and enhance the potency that these animal figures or human figures (especially in trance postures) represent on the rock face ([Rust and Van der Poll, 2011](#); [Mguni, 2015](#)). If these patterns in these images have an entoptic origin, or reflect human perceptions of what happens in the spiritual world, this does not exclude the possibility that such patterns emerge from a prior awareness of such forms in the fossils, rocks and geological landscapes that the artists encountered.

Could some rock art composed of parallel lines (which otherwise may seem obscure) be associated with the distinctive pattern seen in a trilobite fossil? Could an enigmatic geometric spiral motif have its origin in an enrolled trilobite? Could sinuous lines in rock art be related to *Undichna* ([Anderson, 1976](#)) trace fossils made by fishes, which are not uncommonly found in Ecca and Beaufort Groups in the Karoo (e.g. [Smith, 1993](#)), or to wavelike patterns of stromatolites?

4.4. The potential of geomythology in southern Africa

In combination these sites and considerations provide a glimpse into the potential for the study of geomythology in southern Africa. We suspect that there are many more such sites, ‘hidden in plain sight’ within the knowledge base of the public and of experts in various fields, or waiting to be found. This is knowledge that is ready to be tapped, provided word gets out that it is being sought. This knowledge may shed new light on the worldviews and behaviours of our ancestors.

However, there are caveats. Geomythological claims require scrupulous analysis. [Helm \(2013\)](#) adopted a cautious approach, noting that other art in Mokhali Cave may be in the Late White style of Bantu-speaking agriculturalists, and cautioning against the automatic assumption that the dinosaur images that so entranced [Ellenberger et al. \(2005\)](#) were produced by the San.

Furthermore, a healthily sceptical approach recognizes that it is virtually impossible to determine the exact meaning and intention of a work of art, especially when such attempts occur over significant chasms of time and culture. Consequently, we may never totally understand what a prehistoric rock art image meant to its creator, or why a quartz crystal was found in the orbit of a buried infant. A wise approach would be to express interpretations in terms of probability rather than in absolute terms. Hence, for example, we interpret the tridactyl engraving at Boesmanskop as a possible, but not definite, rendition of a theropod track.

That said, it is likely that members of pre-colonial cultures were aware of periods before their existence in the mythological world (e.g. [Miller, 1979](#)); their minds would have had ample opportunity engage daily with the landscapes around them, and to read the rocks. Moving between realms, between the spiritual/imaginative world and the world of reality, was fluid, and connecting with the spiritual potency of mystical beings from the past was likely highly achievable during ritual activities.

Their acute awareness of their environment, including observations of ichnological or skeletal evidence of large creatures that were no longer present, might have played a major role in conjuring up mind pictures of such creatures; it would be surprising if taking cognizance of fossilized tracks would not have enjoyed a high value. Conjuring up the height, weight, and overall morphology of such creatures would likely have been straightforward in their boundless imagination of the past and the present, leading perhaps to the developments over time of myths like //Khwai-hemm / Kholumolomo.

The Mokhali Cave example, with its incorporation of the ethnography of [Bleek and Lloyd \(1911\)](#) and the invocation of //Khwai-hemm (or Kholumolomo) most closely approximates the original, narrower definition of geomythology of [Vitaliano \(1973\)](#). Buttressing this approach are reports from ichnologists who visit Lesotho, and report that the Basotho call all dinosaur footprints the “tracks of the Kholumolomo”. When local residents curiously ask what the scientists are looking for, the standard answer is that they are tracking Kholumolomo (pers. comm. Emese Borden, 2017).

[Lewis-Williams \(2006\)](#) provided a summary of the evolution of southern African rock art research and interpretation. Implicit in such an evolving framework is being open to new ideas. Perhaps seeing indigenous rock art through the lens of an ichnologist or palaeontologist and acknowledging the natural palaeontological knowledge of non-western cultures may benefit research into rock art.

The contention that southern African rock art represents awareness of extinct creatures such as dinosaurs that predates the first formal scientific descriptions, and in some respects eclipses them in terms of accuracy ([Ellenberger et al., 2005](#)) has implications for the region in terms of heritage appreciation. This can become a rightful source of pride and celebration, lending itself to interpretation and education initiatives (e.g. [Aronson and Mayor, 2014](#)). In countries re-forging their cultural identity after a colonial past, yesterday's curious collectors may become an inspiration for a new generation of southern African palaeoscientists.

The sites we have listed, summarizing our current state of knowledge, have a uniquely African flavor, while also sharing commonalities with sites on other continents. Dividing them into categories may be helpful to aid current understanding and to facilitate future research. Within categories, and between categories, there may be examples that are more certain and compelling, and others that are more speculative and less certain. Our categories include:

4.4.1. Sites where fossils are found that are obviously out of context (manuports)

To us these sites speak compellingly of a non-western, indigenous palaeontology or at least an aesthetic geological awareness. They

imply that a fossil or intriguing rock was noticed, was recognized for being out of the ordinary, and was of sufficient curiosity or value to warrant transportation for considerable distances and stored. The Makapansgat cobble, the Griqua *Mesosaurus*, Bolahla, Shelter OP10 at Vleiplaas and Klipfonteinrand (both in the Cederberg), Cave 17 at Robberg and Lucca 54 MS sites fall into this category, as do fulgurites. Oakhurst Shelter, Wonderwerk Cave, Jubilee Shelter and Andriesgrond Rock-shelter, featuring quartz crystals or pebbles, provide further examples. The similarities between Shelter OP10 and Cave 17 are remarkable: both sites involve impressive trilobites being recognized and transported significant distances (at least 10 km and 18 km respectively). The Klipfonteinrand shelter represents a third trilobite manuport site, albeit with a shorter minimum transportation distance of 400 m.

The terms 'rain teeth' and 'lightning teeth' for fulgurites (Marshall, 1999), used by !Kung ritual specialists, imply astute observation of natural and geological phenomena, and the incorporation of the resulting knowledge into the related ritual of rain-making. In the sands of the Kalahari Desert these fulgurites may have assumed greater significance than in areas with substantial bedrock exposures. They are indeed manuports, with the difference that they were not necessarily deposited in a shelter, but instead were placed in a horn and used in rain- and lightning-related rituals. This case is therefore unique in our study in that there is no reported site, but rather a recognition of natural knowledge obtained through accurate reporting of the perspicacity and customs of the San.

4.4.2. Pictographs and petroglyphs that suggest an awareness of and a celebration of fossils or geology

Mokhali Cave, Boesmanskop, Sevilla and the WP site fall into this category. Mokhali Cave is the most compelling, whereas Sevilla is more speculative, with Boesmanskop falling somewhere in between. The WP site is unique in that paint was deliberately applied onto a quartz vein.

4.4.3. Associations between fossil sites and rock art sites

The Schaaplaats, Avondzon and Cathedral Peak sites fall into this category. Gierliński's interpretation of the very similar Kontrewers site in Poland provides a framework in which to consider the relevance of such southern African sites. Caution must be exercised, as association needs to be distinguished from causation. Dinosaur tracksites and rock art sites are both common in Lesotho and surrounding areas of South Africa. Natural casts of dinosaur tracks often occur on the ceilings of rock overhangs and therefore occur in rock-shelters. It should therefore not be surprising that tracks and art might sometimes be found close to each other. The Esikolweni site provides a sobering example, where the possible sequence of events may invalidate a causative relationship between the dinosaur skeleton and the rock art. The Schaaplaats and Avondzon examples, where there is close proximity between fossils and art, suggest that the association may be more than random. Our hypothesis that fossil sites and rock may be connected in a more intimate way is testable, and therefore disprovable. Comparison of databases of rock art sites and fossil sites would establish if the association is statistically significant, rather than random. Likewise, at sites where rock art and fossils coexist, a study could be performed on the spatial relationship between art and fossil, and whether or not this relationship is significant. Similarly, a study comparing the frequency of sites with undulating-line motifs in rock art with stromatolite exposures may establish if a geographic correlation due to direct inspiration can be demonstrated.

4.4.4. Place names

Skilpadsklip represents the only place name we are aware of that indicates local recognition of a fossil site. While it cannot be

classified as 'pre-western', it provides an example of local knowledge, uninfluenced by scientific interpretation, and suggests that there may be other unrecorded or unrecognized names of this nature. This type of occurrence is important, as such indigenous knowledge has led to the identification of important fossil localities in the past (Xing et al., 2011).

4.4.5. Ethnography

The studies of Bleek and Lloyd (1911) have been justifiably cited, but a dedicated, dispassionate review of all ethnographic studies, considering possible geomythological implications, is required. Earlier published studies may intrinsically be more reliable, as they are less likely to be influenced by western scientific paradigms. An early written record of the Khomulomulo appears in the summary of Basotho customs by D.F. Ellenberger (1912) – it contains no reference to tracks in stone. Folklore on the Khomulomulo is readily available (e.g. Knappert, 1985; Smith, 2000; Couzens, 2005; Savory, 2015). It might not be too late to extract information from elders about the purported relationship between dinosaur tracks and the Khomulomulo. The fulgurite example points to the value of dedicated studies of intact hunter-gatherer communities.

In combination, such endeavours may enable the discovery of new, scientifically meaningful fossil-bearing localities that have long been recognized in popular knowledge, but have remained unknown to academics.

5. Conclusions

Evidence is accumulating that non-western cultures in southern Africa had 'natural knowledge' of palaeontology (in the sense that they knew of fossils) and geology, and incorporated this awareness into their legends, their art, and their understanding of their world. Research into indigenous palaeontology and geology as part of geomythology in southern Africa is an emerging discipline, which will hopefully take its rightful place in the international geomythology lexicon. We believe that geomythology can be a lively, valid and valuable discipline in southern Africa, an exciting interface for the study of archaeology, ichnology, palaeontology, geology, anthropology and ethnography, and well-suited to educational and interpretation initiatives. We contend that the sites we have documented probably represent just a beginning. With more general and specialized awareness of the topic, including the possibility that rock art images may be depictions of fossils such as dinosaur footprints and trilobites, many more sites and examples may become apparent, bolstered by ethnography. Studies to further investigate the potential relationships between fossils and rock art are required in order to establish a more scientific, less speculative foundation for geomythological study in southern Africa.

Declarations of interest

None.

Acknowledgements

We gratefully acknowledge the assistance and support of John Almond, Shaw Badenhorst, Emese Bordy, Kevin Crause, Paloma De La Peña Alonso, Tammy Hodgskiss, Sonja Krueger, Martin Lockley, Philippe Loubry, Alex Mackay, Cebisa Mdekazi, David Mossman, Sven Ouzman, David Pearce, Celeste Rossouw, William Stear, Guy Thesen, Yvette Van Wijk, Bernhard Zipfel, and CapeNature staff Natalie Baker and Johan Huisamen.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

J.B. acknowledges the financial support from the Claude Leon Foundation; the National Research Foundation African Origin

Platform; and the Department of Science and Technology – National Research Foundation Centre of Excellence in Palaeosciences.

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